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ADDRESS

TO THE

Cumberland County Agricultural Society,

AT THEIR FALL MEETING, OCTOBER 1860,

BY

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WHAT SCIENCE HAS DONE AND MAY DO FOR AGRICULTURE.

Mr. Chairman and Gentlemen:

It was not without serious misgivings as to whether I would be able to bring anything interesting before this audience, in the form of a lecture, that I consented to appear before you upon the present occasion. An American audience, and most particularly an American audience during the season of our quadrennial contest for the Presidential chair, is seldom satisfied with any effort upon the rostrum which does not partake of the enthusiastic eloquence, which characterizes the political discourses of the times. European cynics, who sneer at our attempt at popular government, are in the habit of saying that the "Americans become crazy once in four years." My reply to this taunt upon the other side of the Atlantic was, that "it was better to have these periodical fits of insanity than to be affected with the *chronic state* of this disease which characterizes the political state of Europe. Here at home, however, I might remark that whatever term we may apply to that excited state of the American mind, which precedes a Presidential election, it certainly cannot be denied that it is *not* the best time possible to get a candid hearing upon a subject foreign to politics, even though that subject be as important as the one which has called this meeting of your Society together. Upon occasions like this, the orator may add interest to his subject by well arranged interpolations into his remarks, of something drawn from the political spirit of the times, or he may flatter them with highly wrought pictures of the bright side of their character, and please them as farmers, by dwelling on the high state of advancement to which they have brought their noble avocation. But, gentlemen, I am not here to spice my remarks by political interpolations, nor to seek the favorable opinions of farmers by flattering them, with how much they know and how much they have done. I am here rather to dwell upon *how much they have yet to learn*, and how much they should do that *has not been done.* The subject to which I wish to call your attention is that of

THE BEARING OF SCIENCE ON AGRICULTURE.

If there is any one thing which characterizes the spirit of the present age more than another, it is the daring audacity with which it seizes upon all ideas and opinions originating in the past and present, and subjects them to certain recognized methods of investigation. Where physical laws or facts of the material world are concerned, the material observed and the phenomena attending it, classified according to certain principles, constitute science; and science thus resulting in the classification of observed facts and phenomena, affords certain laws, by which certain results can "a priori" be determined and new facts be developed. The active spirit of inquiry of the present age, has allowed few facts in regard to anything long to remain isolated. No sooner is any phenemonon observed, than a score of investigators take it up to see if it does not bear some kind of tangible relations to some other object already observed, or some new object that may be discovered. The idea of an isolated fact, or a phenomenon unexplained, is as abhorrent to the mental activity of the present age, as was the idea of a vacuum supposed to be to nature, by the Florence philosophers of the days of Gallileo. Whereever facts are to be observed, there science has made her way to classify and examine them. No branch of human industry presents more facts than does that of Agriculture. In none are the facts so varied, and in none do they involve more profound principles, and in none will they require for their developement more patient thought, close observation, and accurate experiment. Science has already entered upon her mission here; and although she has accomplished much, yet she has left much more still to be done.

And here let me call your attention to what science has already done for Agriculture. In doing this, it would carry us too far from our subject to dwell upon what she has done in an indirect manner—what she has done for all the several branches of industry from which Agriculture has derived so much of her prosperity—and which has contributed in so high a degree to the happiness of the farmer. Is there any farmer present who thinks he has derived no benefit from science? Why science has had to do with almost every comfort which he enjoys in life. Science has bleached the linen that covers his back—it has colored the coat that keeps him warm—it has made the buttons he carries upon his clothes—it has tanned the leather that protects his feet—it has manufactured the soaps that cleanse his body—it has made the bed upon which he sleeps—it has given rise to extensive branches of industry, which consume his produce and afford him the luxuries and comforts of life in return. It has given him the steam engine and the electric telegraph; and if it has not given him the printing press, it has given him the paper upon which he writes, and the ink with which he writes; he eats his breakfast upon a plate that science has moulded for him from the coarse clay; he cuts his bread with a knife that science has prepared for his use from the dirty ores; he lights his fire to keep him warm and cook his food, with a match that science has taught him how to make; and the very teeth with which he masticates his food, may have been made under the dictates of science, with all the beauty of the original, and with much more durability than they possessed. From the nauseating water of the ocean, the sulphur of some worthless ores of iron, the limestone of our rocks, and the sand of our sea shore, science has taken materials, and taught the art of making glass from them. But for this knowledge, hundreds of people of the present day had been living in habitations with *greased* paper over the window-sash, instead of the pure transparent silicate of soda and lime, which now admits light to their dwellings. Indeed, if all that science has ever done for them, were taken away, they could not even be spared the greased paper; but like the Esquimaux savages, would be living in huts, lighted by a hole, that could only be closed with an opaque plug. It would require an age to tell what science has done for the present age; what it has done for it materially, morally and religiously. Hoarded gold and silver may be lost, moral lessons may be forgotten by an age, and religious instruction may be superceded by outward forms and ceremonies, from which every trace of its spiritual essence has been banished; but the progress of science impresses results upon the destiny of humanity which are immortal: its teachings become part and parcel of our being, and cannot be lost. Do not misunderstand me as saying that scientific progress is of a higher character than moral and religious advancement. It only stands in such relation to these as does the engine upon the railroad to the human freight which it hurls along the iron track.

Had it pleased the Divine Author of our being to afford to Christianity in the 4th century the auxiliary of modern science, Christendom would never have had the dark ages incorporated into its history. Knowledge would never have been locked up in secluded monasteries and cloisters, while ignorance prevailed beyond their walls. Had the strong arm of modern science been but wielded in favor of the civilized nations of Southern Europe, the hordes of barbarians that ravaged the fair plains of classic Italy and Greece had melted away, like the icy glaciers that move down from the mountains over which they passed, before the rays of a summer's sun. Where would have been left the hordes of Atilla, had the eighty-two pounders and the rifled cannon of modern warfare, and the infernal machines of scientific construction been brought to bear upon the followers of the "Scourge of God?"

If you would know what science has done for mankind, read the fate of those nations which in modern times have not drawn strength from its teachings to aid them in their conflicts with those nations that have done so.

Read the history of the red man—go ask the millions of subjects that England rules in India—go count the thousands that fell beneath the British bomb-shells at the bombardment of Canton, and you will see the power which science confers upon man.

The world will never cease to look back with astonishment upon the great mathematician and philosopher of Syracuse, who, from the walls of that city, by his own arm, repelled the repeated attacks of Rome; and yet the destructive machines of Archimedes were harmless play-things when compared with the mighty engines of war which have been developed by modern science. An hour's bombardment of the Malakoff tower presented more frightful examples of destructive power, than an age of the defence of Syracuse could have done. Archimedes boasted that he could have moved the world if his king would but give him a fulcrum for his lever. Modern science has done it without a fulcrum, and has discovered the laws upon which the motion is dependent And great as these physical results are, which have contributed so much to man's material prosperity, they are trifling compared with the *moral* and *intellectual* influence they have exerted upon our race. The varied phenomena of nature, which once overawed and terrified the ignorant man, science has taught him to behold with pleasing reverence. Darkening eclipses, burning comets, blazing meteors,bursting volcanoes,and flashing lightnings, that once betokened dire calamity to an affrighted race, now, through the oracle of modern science, speak volumes to man of the beauty and order that reign in this universe, and of the wisdom and mercy of its Divine Architect. Our school boys now delight in knowledge that the wisest philosophers of ancient Greece and Rome could not attain to. The immortal Pliny lost his life vainly trying to solve that which may now be taught to our most elementary classes in school; and it is said that the great Aristotle, after fifteen years tuition under the immortal Plato, and a life's time devoted to profound study, at last committed suicide because he could not understand principles that are now familiar to every student in our higher schools.—Socrates, with all his wisdom, Plato, with all his profundity, and Aristotle, with all his learning, could not have passed a reasonable examination in the scientific classes of our modern academies. And as man becomes acquainted with the material world, his thoughts are enlarged, his conceptions become clear, and his whole nature is elevated by the more intimate knowledge which his study of the works of the Divine Architect affords him of Deity. And if science has done all this, where is the man so ungrateful, as not to acknowledge his indebtedness to her? But I am not here to pour encomiums upon science, confident of her magnitude amongst the causes that have made the present age what it is: she needs none. Confident that when the highest pinacle shall have been completed upon the templ of human progress, the history of her efforts will be written upon every stone from foundation to highest point, science now rests satisfied with the present, and hopeful of the future.

But I am here to tell you what science has done, more especially for Agriculture. I might ask you to point to the farmer for whom science has done nothing. Did I feel disposed to draw upon your sense of the ludicrous, I might portray to your imagination an ideal farmer, for whom science had done nothing—a follower of your noble avocation who had been bereft of all the advantages that science had conferred upon him, he would be a most forlorn and ludicrous figure, I assure you. The well-pecked chicken which, in an unequal contest with its crowing rival, has lost half of its feathers, and is running before its victorious adversary for a place wherein to hide its head, would be a dignified personage, compared with a farmer who has been stript of all the blessings which science had conferred upon him. And yet, men sometimes frown upon science, and wish to be considered as *purely "practical men."* Why the only purely practical men we have in this sense, are the uncultivated savages of the woods! The Esquimaux of Greenland is such a practical man. But the cases to which reference has been made, are those of blessings conferred by science upon *all men* in common with the farmer. We must notice what science has done, is doing, and may do, more especially for Agriculture. It must be admitted, that Agriculture has not derived as much special benefit from science as it should have done; it has not derived as much from it as other departments of industry, although it is capable of conferring far greater benefits upon Agriculture than upon these.

While science has taught the iron-master how to work over old slags that were formerly considered worthless; while it has enabled the refiner of precious metals to get small quantities of gold from silver that formerly was of no value, because it could not be extracted at a paying price; while thousands of valuable materials that once were of no value at all, are now being gathered up and manufactured under the dictates of science into articles of luxury and comfort, and giving rise to new industrial occupations. While the mariner upon the high seas has been taught by science to avoid adverse winds and boisterous storms; while, indeed, almost every other occupation has drawn great special advantages from scientific teachings, Agriculture, in our country, is jogging along, unaided by science, at the old rate of our forefathers of half a crop, one-fourth of a crop, or no crop at all to the acre. The advantage it has derived from science has been forced upon it, rather than coming as the result of its own invitations. We have been retrograding rather than progressing in that which constitutes the fundamental basis of all agricultural theory and practice. I mean the *rotation of crops*, and the *maintenance of consant fertility* in the soil. What progress we have been making, has been rather in our means of *exhausting our soils*, than in those of returning to them that which will maintain them in a constant state of fertility. In the absence of reliable agricultural statistics, it is not possible to state the exact rate of retrogradation in the amount of produce per acre, which characterizes our present mode of farming, but it has been admitted by as high an authority as our great political economist CAREY, that the annual produce of our fields is becoming less; and my own observation has taught me, that in those parts of our country which have been longest settled, the land is the most exhausted; and in some parts of our old counties, which were not originally endowed with a large share of those elements, of which continual cropping exhausts the land, (for instance, on the metamorphic and older Paleozoic rocks of Chester and Lancaster counties,) the present system of farming has almost come to a stand still, in consequence of the exhausted condition of the soil. The land is worn out, new land must be worked while it is "resting." It is well for us that we have new land. The time will come when the land must find rest by letting the people starve. Before that time comes, let us hope that science will be appreciated and her teachings heeded, and that the farmer will learn to restore the exhausted materials that he annually takes from his land in grain and meat, by affording that land its proper supply of artificial manures, which will bring back the exhausted materials. At least we may hope that our farmers shall have made as much progress in this direction as have our English cousins upon the other side of the Atlantic. Our American system has not advanced much beyond the old plan of stable manure and lime; and so far as the material external to the land is concerned, the only manure it receives is lime. As the man who wished to live economically, used to eat an apple for breakfast, to drink water to swell it for dinner, and for sound sleeping to go to bed with an empty stomach; so the farmer has hoped to lime the land for one crop, to let it work for the next, and to get a third on the strength of the first two; and thus go on indefinitely, hoping that this lime will supply the land with some eight or ten different substances, not an atom of one of which it contains or brings to the soil. If properly farmed, land needs no rest: you might as well talk of a steam engine wanting rest when it wanted fuel. The land wants artificial manure!

GUANO OR SUPER PHOSPHATE.

It is true that much guano has recently been introduced into this country. Thousands of bushels of wheat have been raised that would not have been raised but for this article. Land that was not capable of producing four bushels of wheat to the acre, has been made to produce fifteen or twenty bushels, by the aid of this manure. But the subject has been regulated by no fixed principle. No general means of ascertaining its value has been adopted, and no adequate precaution has been taken to ensure the purchaser against the greatest frauds; and were no frauds committed, no means have been adopted of ascertaining when it should be applied, and when it should not. From first to last, the whole traffic in guano has been so mixed up with quackery, fraud and ignorance, that such consequences have followed from its uses as to either leave the farmer disgusted with it altogether, or utterly bewildered as to the nature of its workings and its value as a manure. Some years ago, in Chester county, I had some farming to do myself, and attempted to use artificial manures, but found it impossible to do so, in consequence of the frauds perpetrated in their sale. One that I bought at the rate of $30 00 per ton, turned out to be a mixture of leached ashes, common loam, and a little gypsum. When an experimental agricultural chemist in England, about two years ago, an "American fish guano," that had been shipped to that country, for sale, was brought to me for examination, and it was found to be worth about as much as good garden loam. And quite recently, at the Farm School, I analyzed a manure, of which a large quantity was offered for sale in Philadelphia, at $30 00 per ton, it proved to be not worth $5 00 per ton. My friend, Professor Vœlckler, of the Royal Agricultural College of Cirencester, England, and also chemist to the Royal Agricultural Society of Great Britain, remarked to me in conversing upon the subject, that "he had examined several of the American artificial manures, and that they were the *most infamous cheats he had ever seen*—that the worthlessness of the manure was only equalled by the audacity with which its good qualities were blazoned forth by advertisements—that the shameful recommendations of these, given by certain chemists, (whose names I was sorry to hear mentioned in the connection,) could only be accounted for on the supposition of a most criminal ignorance of the subject they attempted to pass an opinion upon, or by an equally criminal co-partnership with the manufacturers in the division of the proceeds of the sales." You must not understand me as saying that I know that all our artificial manures, that are in the market, are worthless, or are sold at too high rates. I have not yet had time to give them such an examination as would enable me to pass an opinion upon them; but I would call your attention to the fact that the whole business of the manufacture and sale needs a thorough investigation. It is to the interest alike of the farmer and the honest scientific manufacturer that this be done, in order that the former need not be cheated, and the latter may not be obliged to enter the markets upon simply equal advantages with quacks. Nothing but an appeal to science can protect the farmer here, and until the sale of these substances is brought upon the fair basis of a well-regulated system of establishing quality and price, the farmer never will be safe in purchasing, and the use of manufactured manure cannot become general. At present we must remark, so far as agricultural practice has derived benefit from these artificial manures, and from guano, *it owes the advantage gained to science.* So far as it has been cheated by these, it is indebted to its *ignorance of science.* Such is a little of the experience of this country in regard to the advantages of science to Agriculture. In order to see more clearly, not only what science may do, but what she has already done, we may go to England.

England is a preeminently practical country. She always endeavors to get back her full twenty shillings for every pound that she expends. Yet England expends millions of dollars annually for artificial manures. Professor Anderson, consulting chemist to the Highland Agricultural Society of Scotland, in a lecture delivered before that body recently, gave the following estimate as to the amount expended by the farmers of Great Britain for artificial manures: "It is not possible to do this with absolute accuracy, but an approximation can be made which cannot be far from the truth. I find, on referring to the Board of Trade returns for 1858, that the value of guano imported and retained for home consumption, amounted to £3,857,424. This sum, however, appears to be above the average of 1859, which was much below this, but on the whole, it appears that we will consume every year somewhere about £2,500,000 in value of guano. Every year there is imported nearly 26,000 tons of nitrate of soda, and making a liberal allowance for the quantity consumed for other purposes, we will say that 18,000 tons are consumed for agricultural purposes, which will make an annual value of £225,000. Of bones, there are imported every year 84,000 tons, besides a quantity collected in this country. Of these, 80,000 tons are employed for agricultural purposes, one-half as bones, the other half as super phosphate. We find that the value of 40,000 tons of bones, at £6 a ton, is £240,000, and that the value of 40,000 tons of super phosphate, at £7 a ton, is £280,000. The consumption of caprolites annually cannot be estimated correctly, but I understand it is about 50,000 tons, which yield 75,000 tons of super phosphate. This, at £5 per ton, makes £375,000. The value of the consumption of sulphate of ammonia, is £150,000 a year, and allowing for other articles, the sum of £100,000 we have for the total in this country the sum of £4,010,000."

That is, Great Britain and Ireland, with a superficial area of 116,700 miles sq. an area less than three times this State, consumes annually about $20,000,000 wroth of artificial manures, an amount equal in value to one twenty-eighth the entire taxable property in Pennsylvania. And this is done in a country which is not exporting the produce of its soil to other countries in corn and wheat; on the contrary, is importing 1-8th of the grain it consumes. We, here in America, with a territorial area of more than *thirty times* that of Great Britain, have not even developed any reliable plan for dealing in artificial manures, much less in using them in such enormous quantities. But it is by no means on all parts of the cultivated land of Great Britain, that this enormous capital in artificial manures is invested. Ireland has not yet received her share of it. And in England there is still to be found the old conservative farmers, who will not yield to modern innovation, and who thus afford all over the island interesting antiquarian specimens of what English farming was, in some respects, when the agricultural produce of the country was scarcely half as great at it now is.

The almost total absence of agricultural statistics in this country, forbids a fair comparison of what we are doing here, with what Great Britain has done.

But we may learn something by looking for one moment more closely at the statistics furnished by Great Britain.

In an able paper presented by C. W. Hoskyns, Esq., to the Royal Agricultural Society of England, and published in xvi. vol. pp. 554–606 of the Society's Journal, he informs us from data collected for this purpose, that in 1854, in England, Scotland and Ireland, the following amounts of land were cultivated for raising the kinds of grain indicated:

SUMMARY OF CROPS RAISED IN GREAT BRITAIN AND IRELAND IN 1854.

Crops grown.	*England.*	*Scotland.*	*Ireland.*
Wheat,	3,807,846	168,216	411,284
Barley,	2,667,776	207,507	"
Oats,	1,302,782	932,994	2,045,298
Beans,	698,188	37,702	
Peas,		6,119	
Turnips,	2,207,200	433,915	418,947
Rye,	73,731	3,809,	287,154*
Vetches,	218,551	13,442	
Mangold,	177,263	1,946	
Carrots,	12,638	1,218	
Potatoes,	192,287	143,032	989,660
Cabbages,	97,334	1,395	
Flax,	10,186	6,670	151,403
Hops,	18,976	"	
Osiers,	1,079	"	
Bigg or Bere,	"	18,118	
Turnip seed,	"	1,429	
Meadow, Clover, Lucerne, &c.,	2,889,316	1,427,790	1,257,864
Bare Fallow,	895,969	26,128	?
Total under tillage,	15,271,122	3,431,430	5,561,610
Other farm land, &c.,			3,437,430
Permanent pasture,	8,874,940	1,207,101	
Irrigated Meadow,	1.292,329		
Sheep Walks,	2,224,862	6,530,843	
Woods, Walks, unimproved, &c.,	6,298,128	6,947,481	7,731,000

* Including, also, Bere, Barley, Beans and Peas.

The foregoing, with some other items, make for England, 37,324,915 acres; for Scotland, 20,047,402 acres; and for Ireland, 20,399,608 acres; but as the permanent pasture, irrigated meadows, &c., would not receive the artificial manure applied, the latter must be referred to the "Total under Tillage," and the above figures give for the total cultivated land in Great Britain and Ireland almost 25,000,000 acres, and when we reflect that the principal part of the artificial manures we have considered, goes upon this tilled land, we have nearly one dollar per acre expended for artificial manures annually upon evrey acre of tilled ground in the British Islands. But we must look a little closer, and see the character of the crops raised, and we will find a much higher amount of manure used upon that land which really needs it. The sum total of acres upon which our great exhausting cereal crops, wheat, barley, and oats are raised, is

For England, about	9,700,000 acres.
Scotland, "	1,300,000 acres.
Ireland, "	2,400,000 acres.
Total,	11,400,000 acres.

Which will give an average of $2 00 per acre expended in artificial manures for every acre of cereal produce grown upon the land. Were an equal amount expended upon our American acres for 10 years, it would revolutionize the entire agricultural character of the country.

But this merely shows how much money the English farmer expends for artificial manures, and leaves us to rely upon his good judgment as to whether it is advisable to do so or not. But if we look a little further, we will see some of the results of the system under consideration. Let us contrast it with the old system of farming in the same country; such a contrast will show us that all the immense turnip culture is a clear gain afforded by science to the English farmer. The

2,207,200 acres of turnips in England,
433,915 " " " Scotland,
418,947 " " " Ireland,

Making a total of 3,060 062 acres producing from 8 to 15 dollars per acre—making an aggregate of over $20,000,000 for Great

Britain. All this immense crop has been the result of the modern system of farming by the use of artificial manures. The turnips are raised upon land at such time as it was formerly allowed to lay idle. The old system of farming consisted of what was called the three course system, viz:

1st Oats sown in the spring, and cut off at harvest.
2d. Wheat (or Rye) after Oats, and cut next year.
3d. Fallow, until next spring, or over the next year.
(*Morton—Article Agriculture, P.* 766.)

In some parts of England, where grass could be grown to advantage, two or three grain crops would be taken from the land, and then it would be left to grow grass for three or four years, or until it failed to yield grass without resowing.

But this *three course system*, which gave *two crops*, and these *poor ones*, in *three years*, has been replaced by a *four course system*, viz:

1st. Wheat sown in the autumn and cut next harvest.
2d. Turnips—next June following with ashes and super-phosphate.
3d. Barley—next spring clover sown with it on the ground, and
4th. Clover—next year.

I cannot do better than to quote from *Morton's Cyclopedia of Agriculture, page* 765—*Article* "*Crops.*" He says: "Here in Norfolk, the four course system had its origin, and here it is practiced in the best style. But this county, which was the first to break through the system of cropping as long as the ground would yield grain, is now beginning to amend its own improvements. The ease with which artificial, and other manures, can now be procured, and the readiness with which they may be applied to the land, at any period of the rotation, has taught the enterprising farmers of this county, that the matter for their consideration, in fixing on a course of crops, is simply which, with a given out-lay, will produce the largest return, and at the same time most enrich the land; instead of the four course, the following is adopted by some first-rate farmers: (1st.) Clover, trefoil or peas. (2d.) Wheat. (3d.) Oats. (4th.) Turnips. (5th.) Wheat or Barley. *Every crop is manured for*, either by direct application or by sheep feeding, and on a large farm, where this system has supplanted the four course system, the average produce of corn has increased, in ten years, between 30 and 40 per cent. The extent of land in this farm, upon which wheat is grown, having during that period increased until now it has become one-third greater than it was then. The 4 course is conducted thus: The Clover hay, after being mown, is dunged; a rapid growth of after-math is produced, which is plowed under to enrich the ground for wheat. In spring, the young wheat receives a dressing of 1 cwt. of nitrate of soda, and 2 cwt. of common salt mixed, and sown by hand in two applications, at an interval of three weeks, beginning in March and ending in April. When the wheat is removed, the ground is plowed and sown with rye, which is eaten off in spring, and followed by the turnip crop. Dung, guano, and super-phosphate are applied to turnips, the greater portion of which are consumed in the ground by sheep, which are also cake-fed. The land is thus prepared for barley, which is sown out with red clover, and with trefoil and white clover alternately. No rye grass is sown with the clover, as it is reckoned injurious to the following wheat crop. Many of the best Norfolk farmers do not hoe their wheat crops, as hoeing has been found to increase the proportion of tail in inferior corn. The wheat fields are rolled in the spring, with advantage to the crop."

These remarks relate to one of the finest agricultural districts in England. It is impossible for the lover of rural scenery, who has any taste for Agriculture, to pass through this county without being enraptured with the beauty, regularity, and the order of the fields, and the enormous crops that are waving upon their surface before harvest. The county is noted for its consumption of super-phosphate of lime. This artificial manure is most especially advantageous to the turnip crop, and is hence generally put upon the land immediately before that crop is grown upon it. It would be utterly impracticable to find a market for the millions of bushels of turnips that are thus raised upon land that once lay fallow. But they are fed to stock; more particularly to sheep. These animals thrive well on them during the autumn and winter; and in going through the county at this time of the year, the foreigner is struck with the immense flocks of sheep he sees upon almost every farm, hurdled in the middle of the field, with a turnip cutter near, and perchance a slowly moving peasant turning the crank thereof, while the pieces of the cut-up bulbs are falling into a basket, and the sheep are looking through the hurdles, at the anticipated meal, with more intelligence than he exhibits in preparing it for them. The sheep thus eat up the turnip crop, and then their wool is sent to the manufacturer, and their flesh to the markets, while their manure left upon the land upon which they were hurdled, (the hurdles having been moved over the field as the turnips were consumed) serves as nutriment for the next crop. And thus while the increase of population has been going on at a rapid rate, such has been the improvement in modern modes of culture, that the Island is now almost as competent to supply its agricultural wants, as it was at the beginning of the present century. All classes who have anything to do with Agriculture, are better off now than ever before. The laborer receives better wages than his ancestors, and all the necessaries of life upon which he is so dependent, are very much cheaper than at the beginning of the present century. He lives in circumstances of luxury compared with those in which his grandfather lived. The farmer is better off now than before, notwithstanding the abolition of the "Corn Laws," which it was supposed would be ruinous to the agricultural interests of England. There is scarcely a farm in England becomes vacant by the death or expulsion of a tenant, but before a week the landlord has numerous applicants to fill the vacancy, even though he be a despot with his tenantry, so very desirable is the position of the farmer, and in that country; old as it is, with its prices brought down by competition as they are, and its ports open to foreign importations by a system of free trade, the land owner can make more in rent out of his land, in proportion to what he could make out of the stocks of his country, than could the capitalist in this country in a parallel effort. Within the last fifty years the population has doubled, the consumption of agricultural produce has doubled—and yet the price has fallen from 84s. in the beginning of the century, to as low as 56s. in 1850, per quarter of a ton—(8 bushels.) In the decade following the year 1800, the average annual produce of wheat was 8,152,138; in the corresponding term after 1840, it was 15,142,058. In America, of course, we would find a vastly greater proportional increase, but this is the result of an increase in our number of cultivated acres, an increase in acres greater than an increase of crop. But, in England, the increase is due mainly to the increase in the amount the farmer has been able to produce from the acres, and in addition to this great increase of wheat and other crops, is the increased turnip crop, to which reference has been made, that was almost unknown twenty years ago. It has been estimated by a reliable source, that "throughout Great Britain the same land which at the beginning of the century supported 4000 people, now supports 6000, and they live much better than did their 4000 ancestors."—(*Journal Royal Agricultural Society*, xvi, 576.

During the last twenty years, in Great Britain, a vast amount of land, which was formerly considered altogether irredeemable for agricultural purposes, has been drained, and is now producing excellent crops. Bogs and marshes that once were impassible for the pools and streamlets that covered their surface, are now quite as dry as the finest soils of Cumberland Valley, and much more productive than the latter. It is estimated that in Scotland alone, nearly $50,000,000 have been expended during the last thirty years in draining, and this immense capital could not have been expended, had not the farmer been able to purchase artificial manures to bring up the land when drained to a maximum degree of fertility. It would never pay to expend from $25 to $35 per acre to drain land, if upon that land he could only raise the mere pittance of 10 to 15 bushels of wheat to an acre. He must have 40 to 50 bushels to the acre, and to do this he must have artificial manures, and I am quoting the words of the late editor of the *Dublin Farmer's Gazette,* when I say in regard to Scotland: "There is scarcely a farmer to be found without chemical manures, in some shape or other, and, taking the extent of arable land into consideration, there is probably more guano used in Scotland than in any other country, and in many instances, the expense for artificial manures alone is equal to ½ or even ¾ the entire rent of the land."

And the result of this farming is that unhealthy peat bogs and morasses have been converted into fruitful fields, yielding 20 or 30, 40 or 50 bushels to the acre of wheat. The average yield of wheat produce in England is about thirty bushels, but the average is lowered by many farmers and landlords, who have not awakened up from the antiquated systems of farming of their fathers. In nearly all the farms that I visited, the average produce was over thirty-four bushels, and often large fields averaged over fifty bushels to the acre.

Were we disposed to follow up the improvement which the modern system has introduced in Ireland, we would see results still more marked than in England and Scotland. Not that we would find a better Agriculture, but that it has arisen from a more degraded level. It is hardly possible to imagine a more deplorable state of agricultural practice than that which was generally followed prior to the great calamity which has been attributed to the potato rot in 1846, but which in reality must overtake any country in which a system of Agriculture so miserable is followed, as that which characterized Ireland, previous to the one in question. The land was farmed by farmers who were too poor to improve it. All the manure, that could be found, was put upon it, and a crop of potatoes was taken off; after this, if possible, another crop of potatoes, and two or three crops of oats, until the land was utterly incapable of producing any more. Then it was allowed to lay idle for two or three years, after which it was put through the same exhausting process as before; but this ruinous process is in part being abandoned in Ireland, and in its stead the modern system, which allows capital, enterprise and energy to be brought to bear upon it, and to-day Ireland is in a condition beyond the power of any disaster in the potato crop, to inflict any such injury upon her as that of 1846.

We may next consider briefly some of the means by which these changes were brought about. We will notice some very obvious relations which exist between the growing intelligence of the agricultural community and these results.

AGRICULTURAL INSTITUTIONS FOR THE DISSEMINATION OF AGRICULTURAL KNOWLEDGE.

England, Scotland and Ireland have had, and still have, their *Agricultural Societies*, *Agricultural Schools*, and *Agricultural Colleges*. The subject of Agricultural Science and Agricultural Education and Agricultural Improvement, has been discussed over the entire length and breadth of the land. Their societies have held exhibitions, compared with which, the finest ever held in this country are insignificant. They have offered prices for excellence in manures, in crops, in implements, in stock, in essays, in experiments, in everything that relates to agricultural interest, compared with which our most liberal offers are trifles. One of their first duties has been to solicit the aid of competent scientific men in carrying out their researches. Chemists, Botanists, Entomologists and Geologists have been in their employ, and at the present moment all their leading Agricultural Societies have prominent chemists, whose services are permanently engaged to look after the interests of Agriculture.

The Scotch, at first, took the lead in agricultural improvement, and the spirit of their progress was embodied in the Highland Agricultural Society of Scotland. This society is as old as the present Union of these United States. The first meeting was held in 1783. It commenced by offering premiums for excellence in agricultural productions and agricultural practice. As far back as 1813, it was offering prizes as high as $100 and $200. This society has more recently, in connection with the improvement in live stock, established a Veterinary School at Edinburgh, which educates a number of young men annually in this department. It also has a museum of agricultural models, machines, implements, &c., for which rewards have been paid. Immediately following this society, and indeed growing out of it, to correspond with the advanced state of knowledge of the times, but yet independent of it, was the first Agricultural Chemistry Association. Says the author of the *Dublin Farmer's Gazette :* "It was fortunate for the science of Agriculture in Scotland, a large proportion of her farmers were alive to the fact that the boundary line of practice could only be extended by the expansion and generalyzing of the truths of chemistry, and its cognate sciences; and nothing can more clearly manifest the wide-spread desire for a union between the details of practice and the suggestions of science, than the fact that, in one market place and in the course of one day, *sixty farmers* were found *ready and willing* to subscribe for a period of five years, to obtain the services of an analytical chemist. The merit of suggesting and advocating the establishment of this association, is undoubtedly due to Mr. John Finnie, farmer, Swanston, Mid Lothian; and it is highly honorable to the farmers of Scotland, that one of themselves had the liberal spirit and intelligence to perceive the important results that would necessarily flow, both directly and indirectly, from calling in the aid of chemical science to assist the operations of practical Agriculture, and equally creditable is it to the Lothian farmers, and others, that so many of them came forward, so heartily and liberally, to support Mr. Finnie's scheme. This gentleman had been long impressed with a conviction that *some effectual check should be given to the vast amount of adulteration* practiced in the manufacture of artificial manures at home, and also in those natural substances, such as guano, bones and nitrates, brought from abroad; and he arrived at the just conclusion, that chemistry alone could remedy the evil, and hence occurred the idea of obtaining, for the farmers of Scotland, the services of an analytical chemist. Mr. Finnie further saw that the appointment of such an individual would tend materially to enlighten the farmers in two important points of farm practice—first, as to the best mode of managing and applying home-made manure; and secondly, as regards the relative feeding properties of different substances generally given to live stock. On the 21st of July, 1842, Mr. Finnie addressed a letter to the late Sir Charles Gordon, then Secretary of the Highland Society, containing a request that he would lay it before the Board of Directors for their consideration. This letter embodied the draft of a scheme for the appointment of an analytical chemist, by the Highland Society, to be paid from a subscription fund, altogether distinct from its ordinary revenue. This fund was intended to provide a salary for the chemical officer, of such an amount, as would enable him to make analyses for farmers, at a charge *sufficiently low to induce them to avail themselves of his services, and at the same time so high as to prevent them from occupying his time entirely* in examining and reporting upon substances sent more from *idle curiosity* than practical utility. In answer to this letter, Mr. Finnie only succeeded in obtaining a bare letter of approval, to the effect, 'That the object of the association is highly deserving of the approbation of the Society, and the best wishes of its Directors for its success.' On receiving this intimation, Mr. Finnie abandoned all hopes of the Highland Society taking the initiative in the appointment of an agricultural chemist, but determined not to let the matter drop, he resolved to make an appeal to the agricultural community at large, and thus raise a subscription for the maintenance of a chemist, altogether independent of the Highland Society. He, therefore, drew up a prospectus, and in the course of one market day, in Edinburgh, he had the satisfaction of obtaining the adherence of *sixty farmers* (as just noticed,) to his scheme, all of whom put down their names to the subscription list. Encouraged by this hearty support from his brother farmers, he forthwith applied to David Milne Home, Esq., Milne Garden, and Andrew Coverley, Esq., Advocate, Edinburgh, both of whom entered warmly into the proposal, and promised their co-operation, a promise which they afterwards fulfilled most effectually. The printed prospectus for the establishment of the 'Agricultural Chemistry Association of Scotland,' containing an earnest appeal, both to land-owners and land-occupiers, was then launched, and as the Highland Society held its annual meeting that year in the month of August, Mr. Finnie embraced the excellent opportunity thus afforded, of calling a meeting of the principal supporters and friends of the association, and thus of bringing the objects of it more fully before the public. In addition to this means of publicity, he addressed a circular letter to every landlord and tenant in Scotland, explaining the objects of the association, so that none might be ignorant of what was going on. In July, 1843, the association was fully constituted, with Andrew Coverley, Esq., as an honorary Secretary, and an effective staff of influential noblemen and gentlemen as an acting committee of management, and having a subscription list of £900 per annum, each subscriber guaranteeing the sum put down against his name for five years. The committee then advertised for a chemical officer, in the most widely-circulated Scotch newspapers, and also in several London papers, that were known to be read abroad. The result was, that applications were received from ten individuals, all distinguished for their scientific attainments, and of whom two were foreigners. On carefully comparing and considering the merits of these candidates, the appointment fell on Professor Johnston, of Durham, who having notified his acceptance, thereafter entered upon his duties, with a salary of £500 per annum, and a moderate scale of charges for executing analyses. The association carried on its operations during the five years of Prof. Johnston's engagement, in a steady, useful, and satisfactory manner, by which time the Highland Society saw the importance of having a chemical department in connection with itself; and upon the assurance that the Directors would appoint a chemist, and afford to tenants and farmers the same opportunities of obtaining analyses as before, the *Agricultural Chemistry Association* of Scotland was dissolved; and thus honorably terminated an experiment nobly conceived, and spiritedly conducted. Dr. Thomas Anderson, the present chemical officer of the Highland Society, was then appointed by the Directors, whose labors, and those of his predecessors, have been and continue to be, annually embodied in the Transactions of the Highland Society."—[*Morton's Cyclopedia of Agriculture, Vol. II., p.* 813.]

The Royal Agricultural Society of England was organized in 1828, and the first year its funds, from the subscription of members, amounted to $25,000, and the present annual income and expenditure of the Society is about double this sum. Early in the existence of the Society, its members followed the example of their Scottish neighbors, in consulting chemists upon the several parts of Agriculture in relation to which chemical science had a bearing, and in 1848, the services of J. T. Way, Esq., were permanently engaged as chemist to the Society, and means were afforded him of making investigations upon the several subjects connected with Agriculture.

He first devoted his attention to a subject that needs attention more than almost any other in this country at the present moment. I allude to that of artificial manures. In giving the analysis of some worthless manures, that he there found in the market, he says: [*Journal Royal Agricultural Society,* X. 620.]

"In spite of all that has been said or written on the subject, farmers persist in purchasing from dealers of whom they know little or nothing, manures of which they know even less." He then gives the analysis of several manures, which were about as valuable as—*sand*—manures containing less nitrogen than ordinary bituminous coal, and only a *trace* of phosphoric acid. The following are specimens:

1st. An "*Animal Guano,*" sold at $25 00 per ton, was worth about as much as sand or mould.

2d. A "*Yorkshire Manure,*" sold at $20 00 per ton—also worthless.

3d. A "*Leeds Manure*"—sold in large quantities, was as worthless as the foregoing.

4th. A "*Tillage for Turnips*"—was in reality nothing but *red clay!*

"No wonder," says the chemist, "that no beneficial results attended the use of such manures;" and he goes on to express the opinion that thousands of pounds (£) are thus annually expended for such worthless trash."

Were we to follow up the subject, we would find, in the expulsion of these trashy manures from the market, and in the introduction of good ones in their stead, a real advantage to practical Agriculture, derived from science; a clear gain of thousands of dollars annually.

But chemical science has not only afforded aid to the farmer, in pointing out the adulterations, frauds, and impositions of the ignorant, practiced in the sale of nutriment for plants. It has also performed a similar service in regard to the nutriment of animals. It has detected poisons and adulterations in cattle foods and has exposed the charlatanry of those who would sell "patent cattle foods" with extraordinary fattening qualities.

When I visited the Cirencester Agricultural College about a year ago, Prof. Vœlcker had just discovered the cause of a rape-cake's having killed a number of cattle, to which it was fed—a cause which, but for chemical science, must have ever remained concealed. He had dozens of specimens of worthless manures and cakes that had been brought into the market for sale; and while at Rothamsted I had an excellent opportunity of seeing some experiments instituted by Mr. Lawes, for the purpose of ascertaining the value of some of the celebrated "*cattle foods*," that are sold at enormous prices, for keeping and fattening cattle in the country, and they were found most decisively to *possess none of the great qualities* ascribed to them

But it is useless to illustrate further by example principles so obvious, as those, expressing the relation between the agricultural interest and agricultural science.

Agricultural Education.

But the greatest work with which science has been associated, is that of *Agricultural Education*. It is to this source that we are to look for its greatest worth, and its richest rewards: *until the work of educating the agriculturist, in the principles of his* *arts, shall have been in some measure accomplished. practical Agriculture cannot reap the benefits of agricultural science,* for the obvious reason, that science cannot be *understood* or *applied* without scientific education ; science cannot be reduced in popular lectures to the understanding of persons who have not studied it.

When it becomes so popular as to be understood by a promiscuous audience, who have never been trained in the class-room by the study of its abstractions, it loses that scientific *essence* from which it derives its value, and is therefore no longer science, but simply, to use an English expression, it is so much worthless "*clap trap.*" We must commence with the student, and conduct him through a thorough course of agricultural instruction, in our schools, if we would have farmers who would really understand the scientific principles involved in farming, and until they do *understand* its teachings, they *never will have confidence to follow them.* The present generation is waking up in earnest to this great truth ; but here, as in the other departments to which I have alluded, we are behind our slow-moving neighbors on the other side of the Atlantic, we have made some laudable attempts, but have failed in nearly all of them, and have not succeeded entirely in any of them. But before we consider the subject of Agricultural Education in this country, I would briefly allude to the state of this question in Europe.

AGRICULTURAL EDUCATION IN EUROPE.

In *Great Britain* and *Ireland*, that spirit of agricultural improvement, to which I have alluded, as developing the agricultural resources of the kingdom, did not neglect the subject of Agricultural Education, and almost identical with the time of organizing the Royal Agricultural Society, and appointing a chemist to look after its interests and drive the worthless manures from the market, *The Royal Agricultural College of Cirencester* was founded in the southern part of England. After various degrees of success, and passing through one crisis after another, which seemed to threaten its very existence—after having at one time been under the management of a man qualified to take charge of its literary and educational department, but who was ignorant of practical Agriculture, and at another time under the charge of a man who understood agricultural practice, but who was unable to do justice to the educational department—after attempting a good many experiments which proved unsuccessful—after commencing with a low tuition fee, and requiring the students to perform manual labor, and then abandoning the whole plan of manual labor, except at the option of the student,—In fine, after changing almost all the original plans, and under an entirely new board of managers, and new organization of its professors, and the experience of some years teaching, the Royal Agricultural College at Cirencester, at the present moment, has attained a firm footing in England, and is now in a flourishing condition. The history of its mistakes, its successes, its fortunes, and the perseverence of its friends, is something from which we, upon this side of the Atlantic, can learn much. When I visited it, about a year ago, and informed its Professors that I was about to enter upon duties similar to theirs on this side of the Atlantic, they told me not to get discouraged, to not expect an agricultural community to awake up at once to the importance of an agricultural education; that they had learned, by years of experience, and a struggle that nearly cost the life of their Institution, that such an effort only could succeed by dint of hard labor and continual perseverence. When I visited it, the College had about eighty students and eight professors and teachers; every thing about the building exhibited a degree of completeness, that I would like to see imitated in this country. The College is 3 stories high, 190 feet front, and two long wings extending back, embrace dining-hall, laboratory, museum, lecture-room, study-rooms, and dormitories; the out-buildings were no less complete, and the farm of 450 acres, though of a poor soil naturally, was fast being brought into a state of fertility. The farm and botanical gardens embrace numerous experimental plots, where students could see the effects of different kinds of manures on different crops, and the influence of cultivation upon natural and cultivated plants. The Professor of Chemistry, who was also chemist of the Royal Agricultural Society, had three assistants in the Laboratory, making analyses of different products, (manures, salts, cattle food, &c.,) which also enabled the students to learn something of the frauds of the manure-trade, and the means of detecting them, at the same time that it was protecting the agricultural community from the blunders of the ignorant, or the dishonesty of vicious dealers. There are several smaller agricultural schools in England, in addition to agricultural chairs in several of the higher institutions of learning throughout the country. IRELAND has, at *Glasnevin, near Dublin,* an agricultural institution, of lower grade than that at *Cirencester*, but no less flourishing, in its particular sphere, than the latter. In addition to all the requisite buildings for study, and the purpose of storing grain and breeding cattle, there were two farms, the larger one containing 145 acres, and the smaller one 23 acres, and on these two a different system of rotation of crops is carried out, to enable the student to familiarize himself with a course adapted to small or large farms. But the work of Agricultural Education has not been left to the local efforts of one school alone; all over the country, subordinate agricultural schools have been established. A recent report of Dr. Kirkpatrick, to whose hospitality I was indebted for seeing the Glasnevin School (at the head of which he stands,) about two years ago, states that there are under the management of the Government Commission, 20 agricultural schools, with about 700 students, and each school with a model farm of from 3 to 126 acres attached; there are also of model farm schools, under local management, about an equal number, with an equal number of *students*, and *acres* for them to work. There are also 49 ordinary agricultural schools, with about 1100 students, and each school with a small farm attached, on which the boys learn to work; and for still another class, there are 78 work-house agricultural schools, with farms, having 2000 students. So very different is the state of society in Ireland from anything we have in this country, that it is difficult to co-ordinate these small agricultural schools with anything we have, or need have in this country, but these figures show that Ireland has over 150 agricultural schools of all grades, and a number of students in them that counts by thousands. The results of these schools have been the extension of knowledge, a vast improvement of agricultural practice, and a decided change for the better in the moral tone of the entire community. Crime has been diminished and poverty dispensed with, and a state of things brought about which must prevent a repetition of that dire calamity which spread the death-shroud of starvation over this ill fated island a few years ago. If we cross the channel, we find on the continent no less activity on the subject of Agricultural Education, than that which all these details indicate as characterizing Ireland. We can only now take a glance at the agricultural schools of Germany and France.

AGRICULTURAL EDUCATION IN GERMANY.

Germany, the land of learning—of science—of arts—of profound study—and thorough students—with her half a hundred Universities, well filled with students, under the tuition of the ablest professors in the world. Germany has been first and foremost on the subject of Agricultural Education. It is impossible to do justice in the brief time which I now can devote to this subject, to a question of the magnitude of the Agricultural Institutions of Germany. We can only glance over them, and allow a few statistics to speak for themselves.

I. AGRICULTURAL SOCIETIES.—These exist, as in this country, among the friends of agricultural improvement: they are of a *popular* rather than of an *educational character*, and have for one great object to enlist the attention of the lower classes, the peasantry (a very ignorant class, and dreadfully bound to old time customs,) and uneducated farmers, in modern agricultural improvement.

II. ELEMENTARY AGRICULTURAL SCHOOLS.—There are many grades of these, from those which aim at teaching village vagrants a few simple notions in regard to some branches of agricultural practice or industry, at the same time learning something of the ordinary elementary branches of study, to those in which a regular course of agricultural instruction, in connection with a general school course, embracing the elements of agricultural science, is taught. In these, the students are all from the lower classes of society; classes corresponding to which we have no class in this country, as there exist no such, generally recognized, distinctions in society here as there. The students of these schools do not aspire to become educated in any extended or liberal sense. To use the language of a German friend, who had thought much upon the subject: "Their parents being ignorant, their ancestors in many instances being slaves, and having no family pride to elevate their aspirations, and no high ideal of excellence or of high intellectual attainments in their immediate ancestors, for their imitation, they go to school as *peasants,* feeling their parents were such, and they need be nothing else; and hence it is almost impossible to raise them above their low intellectual condition." They all perform manual labor, but there is a listlessness about them when at work or study, which is not characteristic of the students of the higher schools.

III. Higher Agricultural Schools.—In these a thorough scientific course of instruction is pursued. The student is sometimes a graduate of a University, who, after plodding through the Greek, Latin and Mathematics of the Gymnasium, and having heard the 3 or 4 years course of lectures in the University, goes to the Agricultural School to spend a year or two in learning the more immediate applications of the science to Agriculture; or he may have come from some of the excellent Polytechnic schools or academies of the country, in order to finish the course, that was to fit him for the duties of the farmer's life. These students are such as generally expect to superintend their own farms, or those of other people, or of the State. They come from the higher grades of society, and in general character, more nearly approximate to the character of our American students. Manual labor is optional with them, although they all must see how all kinds of labor are performed. The reason of this will be obvious from the fact, that the class to which they belong, superintends labor rather than performs it, and labor is so abundant and so cheap, that in no instance could it be considered remunerative when performed by students; hence it could not lessen, but rather increase, the cost of tuition.

IV. Agricultural Chairs in Connection with the Universities.—These consist of a Professor of Agriculture, who is appointed in the University, and who takes the student, after the latter has learned, in his regular course, what general science his time and inclination may have allowed him, and teaches him the special applications of the several sciences he has studied to Agriculture. The instruction here is of a high order, though not generally as profound as in the older and more fully established branches of the University course; and there is danger of a student having his attention too much divided by the subject of the University course, to concentrate his attention upon Agriculture.

V. AGRICULTURAL INSTITUTIONS IN CONNECTION WITH THE UNIVERSITY.—These afford facilities for the student to take an agricultural course, independent of the University, or he may be attending the lectures of the latter, while a member of the Agricultural Institution; or on the other hand, the regular student of the University, may, while attending the course in the latter, enjoy the advantages of an agricultural course in connection with the Agricultural Institution. In connection with all the several kinds of institutions, to which reference has been made, there is a greater or less amount of land for the purposes of labor, of illustration, of experiment, &c., &c.

VI. AGRICULTURAL INVESTIGATION STATIONS.—I wish you all to get a clear idea of what these are. Germany is a land of scientific investigation. The great intellectual power of her sons, placed under the surveillance of a relentless despotism, which shackels the political press, and forbids the discussion of all subjects bearing upon the government of the country, has sought objects for its exercise and development, in the investigation of the laws of the material world. She has cradled the natural sciences in their infancy, and done more than any other country in bringing them up to that mature age, which enables them to stand as an omnipotent power amongst the elements of human progress, at the present moment. The clear intellectual perceptions of her philosophers, were first to discover the importance of science to Agriculture, and first to attempt a scientific system of agricultural theory and practice.

The son of a Darmstadt dyer, whose attention was directed to the coloring matters of his father's avocation, became interested in chemistry, and after exhausting the library of his native town in search of chemical experiments, and then attempting to follow up his investigations with a neighboring apothecary, at last wandered off to Paris, and studied under the chemists of that city, and returned home to accept of a professorship in a German University, in his 21st year. The young man LIEBIG, (for it was he,) was not thus admitted at so early an age to so high a position in the land of Universities, without being regarded with jealousy by the other professors in Giessen; but as great merit discards jealousy, and overrides its influence, so Leibig soon found himself a master-spirit amongst those who controlled the affairs of the University, and with liberal means at his disposal, entered upon a course of teaching and investigation, which has entitled him to the honored name of being the father of Organic Chemistry, and the first to collect together all the facts of agricultural science, and develop new facts so as to attempt the construction of an agricultural system, out of the discussion of which almost *all* our knowledge of agricultural science has grown. But for the full development of agricultural science, a vast number of experiments were necessary, both in the field and in the laboratory, in different circumstances of soil, season, climate, plant, manure, &c. Before agricultural science could be brought into the school, it must be developed in the laboratory and field, and for this purpose these *Agricultural Investigation Stations* were instituted. They simply consist of a chemical laboratory, with all its necessary appliances, for agricultural chemical investigation, as for analyzing soils, manures, vegetable products, &c., in connection with sufficient land for field experiment, and stalls for feeding cattle, &c. Their object is to ascertain the influence of the several elements of vegetable nutrition upon plants, when used alone, or in various combinations; also, to investigate questions in vegetable and animal physiology, that have a direct individual bearing upon Agriculture. I should have remarked, in speaking of Agricultural Education in England, that the most complete, and at the same time the most liberally sustained agricultural investigation station in the world, is that in which I worked myself 2½ years in England, and which is sustained at an annual expense of from 6 to 8000 dollars, by J. B. Lawes, Esq., at Rothemsted, about 20 miles north of London. The importance of these investigation stations can hardly be over estimated, as it is to them that we are to look for the solution of many puzzling questions that occur in agricultural practice, and without the solution of which we are unable to teach agricultural science, as it should be taught, in our schools; and the great fact, that while our General Government, and several State Governments, have been spending hundreds of thousands of dollars in other scientific researches, hardly a dollar has been expended in this kind of agricultural investigation, shows how little farmers look after their own interests in the distribution of our public fuands. Not to dwell longer on this subject, I shall close by giving you some statistics in regard to the Agricultural Education of Germany.

Commencing with PRUSSIA, we find the following High Schools:

Eldena, with 1000 acres of land, and a 2 year course of instruction.

Proskau, with 2000 acres " "

Poppelsdorf.—Farm for experiment, &c., excellent collection for illustration in science applied to Agriculture.

Moeglin, 1200 acres, has a 2 year course.

Regenwalde, 1000 acres. " "

Waldau, just opened in 1858.

Neustadt, with farm—2 year course. And an Agricultural Chair in Berlin.

All these schools are well supplied with all the means of agricultural study and practice.

LOWER AGRICULTURAL CHAIRS.—Prussia has 22 *lower Agricultural Schools;* 32 other schools more or less associated with Agriculture, or for the purpose of meadow culture, flax raising, weaving and dairy farming, in addition to a number of other model schools, all over the kingdom for the purpose of advancing interests associated with Agriculture.

2. AUSTRIA.—In this monarchy, we find *eleven Agricultural Chairs* in the Universities, and higher colleges and academies; and of *Higher Agricultural Schools,* it has the

Hungarian—Altenburg Agricultural Academy, founded in 1850.

Prague, " "

Hungarian Chemnitz, " "

and the erection of several other High Agricultural Schools is under contemplation.

In addition to this, Austria has 11 Lower Agricultural Schools.

3. BAVARIA has an important Agricultural College, the *High Central Agricultural School,* at Weyhenstephan, near Munich, in addition to an *Agricultural Chair* in the University at Munich, and 12 other Agricultural Schools in the kingdom.

4. SAXONY.—This little kingdom has one of the best Agricultural Schools in the world, at Tharandt, near Dresden. This is a school of the highest order. Another good school at Chemnitz, another at Lutzschena, near Leipsic, in addition to several smaller schools.

5. THE SMALLER STATES.—Of the smaller States, **HANOVER** has two Agricultural Schools. WURTEMBURG has 4, including HOHENHEIM, one of the best in Europe. BADEN has 4. HESSE has 2. HESSE CASSEL has 1. HESSE HOMBURG 1. **NASSAU** 1. OLDENBURG 1. BRUNSWICK 1. MECKLENBURG 1.—HOLSTEIN and LAUENBURG 4. SAXE-COBURG AND GOTHA 1. SAXE-ALTENBURG 1, and about a dozen other little Kingdoms, States, &c., not much larger than a good sized farm, have each one or more Agricultural Schools, making a total for Germany of about 20 Chairs in her Universities and Academies, and 12 schools of high order for agricultural instruction, in which a thorough course of agricultural theory and practice may be followed. It would require more time to do justice to the schools and colleges that I visited, than I have allowed for all that I intend saying to-day. They number from 50 to 200 students each, and amongst their materials for study, is included every thing that relates to Agriculture, either in a scientific or practical point of view, embracing in the theoretical department, scientific collections in all the sciences, and most particularly those that relate to Agriculture, including the art and science of veterinary, and in the practical part, tuition in the duties of the farm, embracing an arrangement for feeding, brewing and distilling, for brick-making, sugar-making from the sugar-beet for dairy work, raising of improved breeds of stock, and an experimental department for the purpose of developing agricultural science, by investigation upon the growth of crops and the nutrition of animals. In some instances, there are extensive shops for the manufacture of agricultural implements and machines, in connection with these schools, at which not only can the students see different agricultural implements and machines made, but the surrounding country can be supplied with the best articles that are kept anywhere.

AGRICULTURAL EDUCATION OF FRANCE.

If we leave Germany and come to the south of the Rhine, we will find that France is wide awake as to the importance of Agricultural Education, Agricultural Improvement, and Agricultural Science. Though, like Germany, she is far behind England in the richness of her soil, and the produce of her acres, yet she has made great progress, and is now doing much. In no country in the world are all the internal affairs so systematically organized as in France. The size of her bushel, the area of her acre, the length of her yard, the weight of her pound, and the value of her dollar, are all model specimens of these most essential auxiliaries of human progress. She has three celebrated Agricultural Schools of high order, viz:

1st. IMPERIAL AGRICULTURAL SCHOOL OF GRIGNON, near Paris, with eleven Professors and Directors I visited this school in August of last year, just after having made the tour of the principal German Agricultural Schools. It compares well with the latter, though it is not equal to many of them. There is a large farm in connection with the college, and it has all the out-houses for the purposes of dairy feeding, raising stock, &c.

2d. IMPERIAL AGRICULTURAL SCHOOL OF GRAND JOUAN, and

3d. THE IMPERIAL AGRICULTURAL SCHOOL OF LA SAULSAIE. In addition to these three High Schools, there are in the several departments of the Empire, 51 small *farm schools*, as they are called, at which practical farming, with a little of its theory, is taught to the peasant population.

There are also three celebrated Veterinary Colleges in France, viz: that of ALFORT, near Paris; that of LYONS, and that of TOULOUS; and in addition to these, there are several courses of lectures given annually at Paris and the principal towns of the Empire, by some of the ablest men in the country, on various subjects connected with Agriculture.

RUSSIA.—Had we time to go to half-civilized Russia, we would find that she, too, had her Agricultural Schools and Colleges. In fine, Europe has her Agricultural Chairs in her higher institutions of learning by dozens, she has her higher Agricultural Schools by scores, and her lower schools by hundreds.

"Proud Old England," Energetic Scotland, Rising Ireland, Extended Russia, Decaying Austria, Little Denmark and Despotic France—all Europe, from the Mediterrenean to the Baltic, and the Baltic to the Urals, is alive to the subject of Agricultural Education, and what science has done, is doing, and is capable of doing for Agriculture! And we may now come back and ask ourselves what Republican America, what this great agricultural nation, with her millions of broad acres, has done and is doing for Agricultural Education and Agricultural Science, and what Science has done for her? Where are her Agricultural Schools? Where her Agricultural Colleges? Where are her Agricultural Investigations, which are to help the scientific men of the old world, to develop the great principles of Agricultural Science, that must one day be to the farmer what the theory of navigation is to the mariner, or the principles of surveying to the man who measures land? Where are our Agricultural Chemists to point out the frauds and mistakes of our artificial manure manufacturers, &c.? Where are our Agricultural Bureaus to collect agricultural statistics, and enable us to know just what the country is doing and what it is not? We ask and wait! and Echo answers, Where? Michigan's Agricultural College failed, almost before it had an existence. The New York Agricultural College, at Ovid, is struggling into existence, through grinding poverty. Maryland is going on, but not upon a plan adapted to the education of the sons of hard-working northern freemen, who wish their sons to be brought up to the habits of manual labor that they were; and PENNSYLVANIA has come to a stand-still, for want of funds in erecting *her* Agricultural College, before the building is half completed—and we do not possess, from one end of our great country to the other, a single *investigating station*, at which the innumerable questions suggested by agricultural practice, are being solved. Now, gentlemen, let me ask you, why this should be so? Why should Europe be expending her thousands and her millions in agricultural colleges and agricultural investigations; in the manufacture of agricultural artificial manures; in collecting agricultural statistics, and in seeking to take advantage of the teachings of science, while this great Republic, Young, Strong, Wealthy, Enlightened, and Free, has done almost nothing in these several directions? It is not because we cannot afford it—for no nation is richer than ours. It is not because Political excitement consumes our time, for no nation has less to fear from dangers without or from really dangerous commotions within, than ours has, for with all due deference to our nervous political friends, I would confidently assert that our government is just as strong now as it ever was. It is not because we are naturally addicted to the obsolete customs of antiquity—because as a people we are characterized by our disregard for that which is old, and our constant desire for that which is new. We have no antiquity to be wedded to; we live only in the present; we have no past. It is not because we are an ignorant people, and do not appreciate science and education, for no country in the world has been more liberal in its expenditure for popular education than ours, and no people have grasped with more eagerness at the results of science, in other departments, than have our own countrymen. The history of the telegraph, the steam engine, the combustion of fuel, and quite recently the excitement in regard to coal oil in our own State, and scores of other things will prove this. It is not because we have suffered for want of scientific instruction in agricultural practice, that we have not availed ourselves of it, because, no where is there more quackery to expose, and more frauds practiced, and the deplorable results of more ignorance imposed upon the agricultural community, than in this country. It is not because this subject has not been before our legislative bodies, for, and I am sorry to be obliged to own it, a son of Pennsylvania vetoed the first Agricultural College bill that seriously came before our National Legislature. I saw the record of that veto, when a student in the German University on the other side of the Atlantic. I saw it with shame and with sorrow; with shame, that our Chief Executive did not appreciate the claims of Agricultural Education, and with sorrow, that our country would lose the blessings that the bill would have conferred upon the millions of our citizens in the present and in the future, who now cultivate, and will cultivate, our soil.

Then if none of these causes afford a reason for our not having done more, we may again ask, "*Why have we not done it?*" I will at present leave the question, gentlemen, for you to consider, feeling confident that so far as it lies within your power, each and every one of you will labor for such a condition of things in our country, as will make its answer unnecessary.

But I have already trespassed too much upon your time. In conclusion, I will as briefly as possible call your attention to a number of things that ought to be done in this country.

1st. *Agricultural Schools and Colleges.*—We want Agricultural Schools established in our country, at which agricultural principles can be taught, in connection with agricultural practice. These schools must be of a high order. *They must be capable of* *affording the student all the knowledge that science can afford in relation to all the operations of Agriculture.* They must stand in the same relation to Agriculture that our highest Military Academies stand to the art and science of war, or that the Polytechnic Schools of Europe stand to the practical duties of Engineering. Their professors should be a higher class of men in relation to what they have to teach, than those need be who teach the older and more fully developed sciences. Not only must they teach, but they must be capable of collecting together the material they are to teach. They must analyze it, and digest it, and sift out the few valuable facts and principles that are known, from the mass of worthless suggestions and theories, amongst which they are found, and bring these before the student They should be men who are capable of extending the domain of Agricultural Science, in whatever particular department of it they may be called to labor. It is not necessary that a teacher of mathematics and the older sciences, should be capable of extending human knowledge, in any of the departments in which he teaches. He may be an excellent teacher, and yet incapable of attaining to the limits of what is known, much less to penetrate the veil of nature's hidden resources, that have never been opened up to man. But not so with your teacher of Agricultural Science. Not only must he know all that is known, but he must stand upon the outposts of science, and gather new jewels from her unexplored limits. He must be the *investigator* as well as the *teacher*,—the investigator, that he may build up his undeveloped science, and thus know what he teaches. Again, it is more advanced Agricultural Schools, *corresponding to our Colleges*, and not *Elementary Schools*, corresponding to our Common Schools, that is first wanted. An Elementary Agricultural School, without a higher Agricultural School, from whence to get its fundamental ideas, would be but a trashy affair. It would bring contempt upon the whole subject of agricultural instruction. It would be attempting to teach what was not yet known, without any power to extend our knowledge. Such schools would be like a clock without any pendulum, a watch without any balance-wheel—*they would soon go down!*

FARMER'S HIGH SCHOOL OF PENNSYLVANIA.—I may be expected to say something in regard to our Farm School in Centre county, with which I am associated. My time forbids my saying as much as I would like. I must, however, say, that if this Institution is sustained as it should be; if its buildings are completed upon the original plan, and it receives a reasonable support I have not the slightest doubt that it could be made the best Agricultural Institution in the world. This is not merely a "spread eagle declaration," characteristic of American oratory, (and originating in the ignorance of the speaker,) as a somewhat similar expression of mine was supposed to be by an American agricultural editor, some time ago I have visited all the Agricultural Schools of importance in Europe, have examined their system of instruction, and contemplated with them their prospects, and am prepared to say, that if we cannot institute a more complete and thorough theoretical and practical course of instruction at the "*Farm School*" than any of them embrace, we will not have done justice to our subject. We can surpass them, because we possess *much better faculties* for developing such institutions than they possess. We can have a higher order of students than they can have. Our schools can be patronized by, and dignified by the patronage of, a more influential class of people than theirs are. Our students will have more ambition and higher aspirations than theirs have. Our efforts will not be paralyzed by the blighting influence of aristocratic castes as theirs are. Our attempts at uniting agricultural labor with agricultural study will not be crippled by the degradation and cheapness of labor, as theirs have been. Indeed, the entire character of our institutions; the fundamental ideas of our people in regard to the dignity of labor; our general mixing and intermingling of all classes of society, and the growing intelligence of our people, together with the fact, that this is the greatest agricultural community on the face of the earth—all enable us to build up the best Agricultural Schools in the world, and we must do it! *We must do it in Pennsylvania!* and I think, gentlemen, that we *will* do it. On the other hand, if our Farm School does not receive aid to finish its buildings, it must stop, and the money expended on it will become a dead loss. But of this, no one who has any State pride, could think for one moment.

2d. *State Chemists.*—We *must* have State Chemists. Not *honorary officers*, who may, if they choose, spend a fortune out of their own pockets, looking after the agricultural interest, or let the agricultural interest look after itself, according as they are, or are not, willing to make great sacrifices without reward. We must have State Professorships, with salaries, such as will induce competent men to accept them; and they must be supplied with means to carry out the several duties of investigation connected with their office. These professorships could most economically be filled by persons connected with our Agricultural College. The example set us by the English and Scotch Agricultural Societies, to which I have referred, is an excellent one for imitation in this respect.

3d. *Agricultural Scientific Investigation Stations.*—We want Stations for the purpose of conducting experiments, in order to develop the principles of agricultural practice, which must be taught in our schools and followed in our fields, and for the purpose of investigating such questions of agricultural practice as may present themselves for solution. Such a Station should embrace a farm for experiments in the growth of crops, a chemical laboratory for examining them, and stalls, stables, &c., adapted to feeding animals, with a view of estimating the value of different kinds of food for cattle. It would also be well to connect this with an Agricultural College, and the chair of State Chemist, to which I have just referred, although in Europe these Stations are often isolated from both of them.

4th. *Agricultural Statistics.*—We want an organized system, by which Agricultural Statistics can be collected, for the purpose of showing the state of our Agriculture every year. *It is an immense source of wealth to any nation to know just how wealthy she is.* Half the consequences of poverty may be avoided by knowing the extent of poverty. In France, where the stability of government and protection from bloody revolutions is often dependent upon the ability of the rulers to stop the mouths of a hungry populace, these truths are acted upon. A few weeks after harvest, the government knows how much agricultural produce is in the country. It knows what will be wanted by the people, and if there is not sufficient for them, measures are taken in due time, while the prices are reasonable, to secure a proper quantity for consumption. It is impossible to calculate the advantages to the farmer of being able to know, at an early date, just how much grain is in the country, how many cattle for sale, &c. &c. He might, in advance, calculate the price of agricultural products, and not be holding on for a higher price, to be disappointed at last by its falling. But I have not time to enlarge on this subject. And lastly, we want

"*A National Agricultural Bureau*," that should represent the agricultural interest in the National Legislature, and serve as a kind of union between all the isolated agricultural interests of the country; to be in communication with all the State Associations, Agricultural Schools and Colleges, Investigation Stations, State Agricultural Chemists, Collectors of Statistics, &c. &c., to which reference has just been made. It should afford, as far as possible, a connection with similar institutions in Europe, that agricultural science and agricultural progress throughout the world might be encouraged and advanced by the united efforts of all civilized nations in urging it forward, with all the means that the united science and experience and intelligence of the entire world could bring to bear upon the subject. In conclusion, gentlemen, allow me to hope that you will think upon these propositions: they involve questions of far more importance to your interests as farmers, than do a vast number of political questions, to which your attention is much more devoted. Reflect upon them, and urge their consideration of your representatives and legislators in the Legislative Halls of our State and National Capital.

I regret that I have not been able more fully to do justice to this subject, as your patience in standing up here and listening as you have done, has merited an abler effort, but I shall always remember this my first visit to this part of your beautiful valley, with grateful feeling for your attention in listening to a subject which, to me, appears to have been too much neglected upon occasions of this kind.